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THE FRASER RIVER ACTION PLAN

1994-1995
Progress Report

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July 1995

Dear Fraser Basin stakeholder:

FRASER RIVER ACTION PLAN

We are pleased to send you the enclosed **Fraser River Action Plan 1994-95 Progress Report**, which highlights the federal government's activities and progress in the fourth year of this ambitious initiative.

The Fraser River Action Plan (FRAP) was launched in 1991 in response to public concerns about the environment, as well as to mounting pressures on the Fraser Basin's ecosystems from increasing population growth, economic development and demand for resources. The initiative, carried out by Environment Canada and the Department of Fisheries and Oceans, is striving to restore the great river's fish and wildlife, clean up pollution and improve stewardship of the Fraser Basin.

We are also enclosing copies of **Measuring the Health of the River**, a 1995 status report by the Environmental Quality Program of the Fraser River Action Plan, and three new fact sheets produced by FRAP that address important issues on the Fraser.

Today, all of us are more aware than ever that we must protect this vital, yet fragile, watershed. Governments cannot do this alone. The cooperation and involvement of all stakeholders in the basin is crucial to ensuring the long-term environmental health of this important watershed.

Your interest in the Fraser Basin is appreciated.

Yours sincerely,

L. Tousignant
L. Tousignant
Director-General
Pacific Region
Fisheries and Oceans

V. Niemela
V. Niemela
A/Director-General
Pacific and Yukon Region
Environment Canada

Encl.

Canada



Le juillet 1995

Monsieur, Madame,

LE PLAN D'ACTION DU FRASER

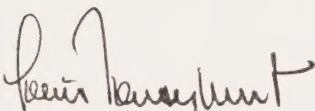
Nous avons le plaisir de vous faire parvenir ci-joint un exemplaire du **Rapport d'étape pour 1994-1995 du Plan d'action du Fraser**.

Lancé en 1991 pour répondre aux préoccupations du public au sujet de la protection de l'environnement, le Plan d'action du Fraser (PAF) a également pour but de trouver des solutions à l'agression croissante des écosystèmes par la croissance démographique, l'expansion industrielle et l'exploitation des ressources. Le programme, mené conjointement par Environnement Canada et par le ministère des Pêches et des Océans (MPO), vise à rétablir les ressources halieutiques et la faune de ce grand fleuve, à le dépolluer et à améliorer la gestion du bassin du Fraser.

Vous trouverez également ci-joint copie d'un rapport de 1995, **Measuring the Health of the River**, produit par le groupe du Plan d'action du Fraser responsable du programme pour la qualité environnementale, ainsi que trois nouvelles fiches d'information du PAF qui traitent d'enjeux importants touchant le Fraser.

Aujourd'hui plus que jamais, nous savons qu'il nous faut protéger cet important mais délicat bassin hydrographique. Le gouvernement ne peut y parvenir seul et il doit pouvoir compter sur la collaboration et l'apport de tous les intervenants pour garantir la santé à long terme du bassin.

Nous vous remercions de votre intérêt pour le bassin du Fraser et nous vous prions d'agrérer, Monsieur, Madame, l'expression de nos sentiments distingués.


L. Tousignant
Directeur général
Région du Pacifique
Pêches et Océans Canada

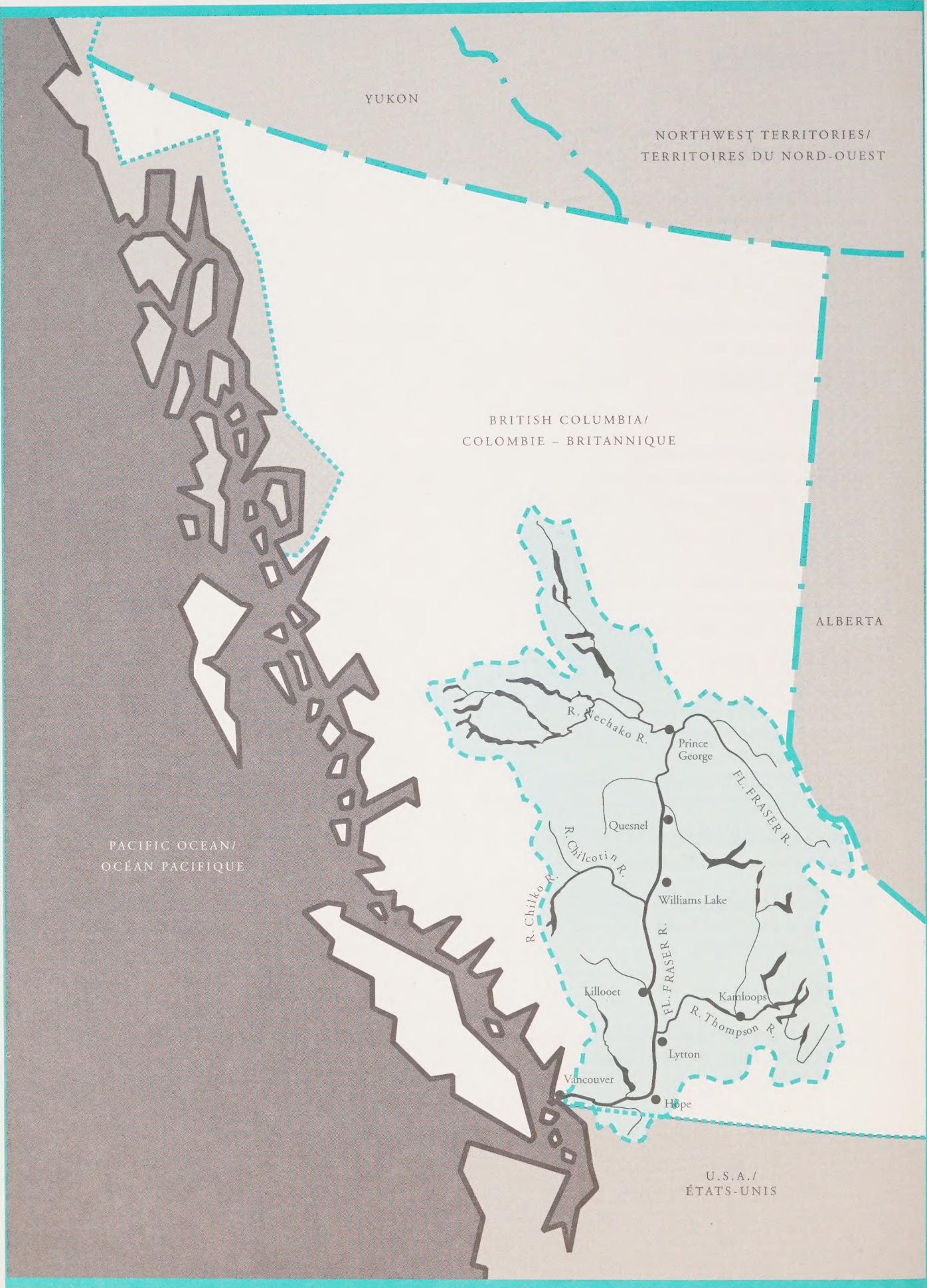

V. Niemela
Directeur général p.i.
Région du Pacifique et du Yukon
Environnement Canada

p.j.

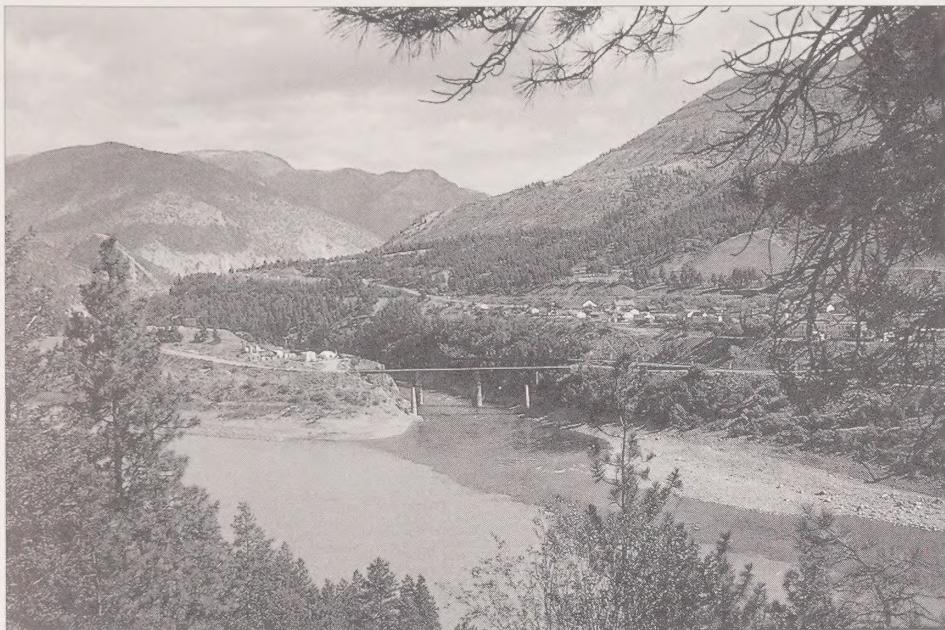
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An Action Plan for the Fraser River



The federal government is working to safeguard the Fraser, one of Canada's most valuable watersheds.

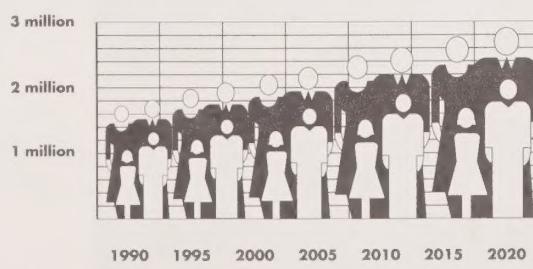
The Fraser Basin

Canada's fourth largest river, the Fraser River flows 1,375 kilometres from the Rocky Mountains to its delta on the shores of the Pacific. The river and its vast network of lakes and tributaries drain a richly varied basin the size of Great Britain. The broad range of ecosystems and climatic zones traversed by the river system represent an abundant diversity of life; the rivers, streams and estuary are among the most productive in the world. The basin is also home to nearly two million people: a population expected to grow by 50% by 2021. Urban and population growth, industrial development and expanding resource extraction all add stresses to the basin's ecosystems in the form of pollution in the river, a decline in some salmon stocks, contaminated water supplies and destruction of fish and wildlife habitat. The warning signs are there to see.

A plan of action

The federal government recognizes that the river is under stress and is striving to improve its long-term health and productivity under a multi-year program called the Fraser River Action Plan or FRAP. This ambitious program, carried out jointly by Environment Canada (DOE) and the Department of Fisheries and Oceans (DFO), encompasses a broad range of activities to achieve three objectives:

- to work with partners and stakeholders to manage the Fraser Basin in a sustainable manner;
- to improve fish and wildlife productivity in the Fraser Basin; and
- to clean up pollution.



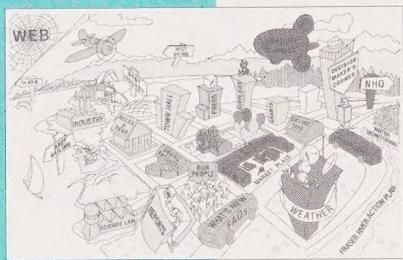
The population of the Lower Fraser Basin is growing rapidly.

Progress Highlights

For four years, FRAP has been pushing ahead on many different fronts toward its objectives.

Building partnerships

Partnerships are the key to the future of the Fraser. Only through the cooperative effort of all stakeholders in the Fraser Basin will the goal of a healthy and viable river for future generations be realized. FRAP is actively helping local citizens and organizations come together to tackle land- and water-use conflicts in seven demonstration watersheds across the Fraser Basin. These communities are showing how partnerships can help resolve difficult environmental management issues – their efforts will provide lessons for the stewardship of the entire Fraser watershed. FRAP also helped to create the Fraser Basin Management Board to bring together the four levels of government and a wide variety of other stakeholders.



FRAP information is now available via the Internet. Point your web browser at <http://www.pwc.bc.doe.ca/buildings/frap/index.html>

In partnership with the provincial government, FRAP is devising ways to protect the diversity of forest habitats critical for birds. This strategy has already borne fruit: the B.C. government has created new protected areas in the Cariboo-Chilcotin region including 135,000 hectares of important migratory bird habitat and another 100,000 hectares of significant wetland.

FRAP is working with the Province of B.C. and municipal governments, planners, developers and other key stakeholders to protect fish habitat in urban streams and other environmentally sensitive areas. The goal is to prevent habitat loss before it occurs by making these groups more aware of habitat values and by finding ways to minimize the environmental impacts of development.

Advancing knowledge about the Fraser River

A major part of cleaning up pollution is to define the health of the Fraser River and its tributaries. This will provide a baseline against which to measure the success of cleanup efforts and help point the way toward sustainable use of the river. Results so far indicate, for example, that dioxin and furan levels in fish and birds are decreasing, thanks to process changes in pulp mill technology.

FRAP scientists are increasing knowledge vital to the management of the Fraser's salmon stocks and habitat. The Fraser River Sockeye Public Review Board, which investigated the shortfall of sockeye salmon returning to spawning grounds in the Fraser River watershed in 1994, recommended changes to improve salmon management. FRAP has already been addressing many of these concerns including developing a computer model that will predict water temperatures and water flows in the Fraser River and conducting research to determine the effects of logging on water temperatures and salmon stocks. FRAP is also striving to improve management of Fraser salmon by developing a comprehensive, long-term plan to sustain and rebuild stocks.

Protecting fish and wildlife habitat

Habitat is critical to species survival and viability: if we protect and improve habitat in streams, forests, marshes and wetlands, fish and wildlife will thrive and increase.

Projects to enhance fish habitat in more than two dozen locations have created or improved over 167,000 square metres of spawning or rearing habitat and have improved



A biologist takes a blood sample from a young salmon, as part of FRAP's extensive science program to increase knowledge of the Fraser.

habitat on about 70 km of streams. The expected benefits in terms of greater returning salmon adults can be measured in the tens of thousands, while anticipated gains for fry and smolts are in the hundreds of thousands.

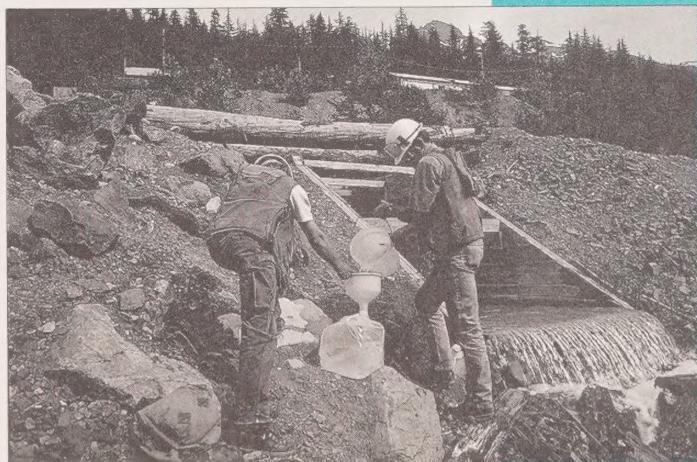
By acquiring key parcels of land and through cost-sharing stewardship programs with landowners, FRAP has directly protected or enhanced a total of 2,742 hectares of wildlife habitat.

Cleaning up pollution

One way that FRAP is reducing pollution is through enforcement of regulations under the Fisheries Act (FA) and the Canadian Environmental Protection Act (CEPA). FRAP is targeting the worst polluters in the basin, with an overall goal of over 90% compliance with regulations. Compliance rates continue to vary from sector to sector, ranging from 73% to 100%.

Preventing pollution by encouraging industry and agriculture to adopt environmentally responsible codes of practice and guidelines is another successful FRAP approach. One code of practice, developed for the ready-mix concrete sector, has generated interest from many plants in B.C. and has become a model for ready-mix associations in Alberta, the United States and Europe.

The following report presents a selection of FRAP's activities, focusing on 1994-1995.



Enforcement officers sampling effluent from a mine outflow. (Photo: G. Mitchell)

Across the Basin

Many of FRAP's activities are basin-wide in approach, or can best be understood by reviewing them across the basin as a whole. From demonstration watersheds to pollution cleanup strategies, salmon rebuilding programs to environmental quality assessments, the plan reaches out to each part of the Fraser Basin.



Demonstration watersheds

Models of stewardship

Demonstration watersheds are models of cooperative action that bring together local citizens with different needs and views to find a common vision for their watershed. Microcosms of the whole Fraser Basin, these sub-basins will also provide valuable lessons for the stewardship of the entire watershed.

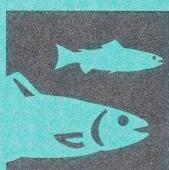
FRAP is now an active partner in seven demonstration watersheds: the Salmon River (Langley), Salmon River (Salmon Arm), Nicola River (Merritt), Nahatlatch River (Boston Bar), Fraser River (Prince George), Baker Creek (Quesnel) and Alouette River (Maple Ridge).



Members of the Salmon River round table (Salmon Arm) discuss issues crucial to their watershed.

Round tables – toward a common vision

Demonstration watersheds work by creating a round table – a group of local people with many points of view – which guides land and water-use planning in each watershed. By bringing together all views and interests, the process seeks to resolve conflicts and allows the community to make decisions on how to achieve sustainability. FRAP plays a crucial role by providing seed money to get round tables up and running. The program also provides advice and technical assistance to local round tables, carries out hands-on habitat restoration and holds workshops.



Fish habitat restoration

FRAP is working with partners protecting and restoring fish habitat on big and small streams in more than two dozen locations throughout the Fraser Basin. Biologists and engineers are in the field from the Fraser estuary to Prince George rebuilding marshes and sloughs, reclaiming habitat below hydro dams, removing barriers to fish migration, improving water flows, stabilizing river banks and protecting streamside vegetation. Each project contributes to FRAP's goal of increasing salmon populations, since habitat is the foundation of fish survival and production.

In the past four years, more than 167,000 m² of spawning or rearing habitat have been created or improved. As well, habitat on about 70 km of streams has been improved, including reduced siltation through bank stabilization and fencing on 35 km of the Chilliwack River and tree planting, bank stabilization on many other streams to improve rearing habitat. Appendix A presents details of these projects and their expected benefits for salmon.

Protecting wildlife

FRAP has devoted considerable effort to restoring and protecting wildlife habitat, which has been threatened or damaged by development, industrialization, resource extraction and other human activities.



Conserving estuary wildlife habitat

Millions of waterfowl and shorebirds winter in the Fraser estuary, and FRAP is funding several projects that aim to protect and enhance critical feeding and staging habitat for the migrating birds. FRAP has completed a detailed inventory of wetlands from the Fraser's mouth to Hope. This inventory, which also charts ownership and levels and types of protection as well as potential threats to wetlands, is a valuable aid in regional and municipal land-use planning and is expected to ensure that wetlands are well represented in the Protected Areas process in the Lower Mainland. Buying up critical wildlife habitat is another approach used by FRAP. Through a partnership with the B.C. government, other federal agencies and conservation organizations, FRAP has contributed to the purchase of 98 hectares of delta wetlands under the Pacific Estuary Conservation Program.



FRAP is safeguarding habitat vital to waterfowl.

Protecting interior wetlands

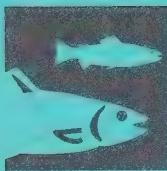
Another FRAP program focuses on the basin's interior wetlands. Run in partnership with Ducks Unlimited and the Province of B.C., the program's goal is to promote land-use practices that maintain and protect habitat for migratory birds and other wetland-dependent wildlife, to protect water supplies and water quality and to encourage sustainable agriculture. The Interior Wetlands Program has designated seven demonstration projects in the interior that provide good examples of cooperative local action and environmentally responsible land-use practices. Follow-up evaluations form a key part of demonstration projects. These assess what impacts the projects have had on wildlife habitat, biodiversity and water quality.



Protecting forest biodiversity is an important FRAP goal.

Forest ecosystems

Over 90% of the Fraser Basin is forest, and FRAP aims to conserve and protect the ecosystems and diversity of forest species in several ways. Identification of critical forest sites and habitats is the first step, and FRAP and its partners have completed a basin-wide inventory and are now working with the provincial government to ensure that these identified ecosystems are considered within the Protected Areas Strategy. This approach has already borne fruit: the B.C. government has created new protected areas in the Cariboo-Chilcotin region, including 135,000 hectares of important migratory bird habitat and another 100,000 hectares of significant wetland. FRAP is also developing decision-making tools and information for forest managers. Appendix B provides further details on wildlife projects.



Managing salmon for the long-term

One of FRAP's three main goals is to restore the productivity of the Fraser, including the rebuilding of salmon stocks. A key initiative to achieve this is the development of a comprehensive plan to manage Fraser salmon and coordinate rebuilding efforts over the next decade.



FRAP's blueprint for managing salmon will be a cornerstone of the fishery for years to come.

The need for a plan

Most Fraser River salmon stocks remain relatively healthy, although some, coho and steelhead in particular, are showing signs of stress from habitat degradation and overfishing. Recent problems with sockeye spawning numbers underline the need for management measures to deal with rapid change in the fishery and the threat of climate warming. The challenge is to manage and enhance Fraser River fish stocks and their habitats for the benefit of future generations while accommodating other present and future uses of the river.

A plan for all seasons

The management plan is bringing all the elements and stakeholders together. It aims to integrate the management of the fishery – catch allocations, fishery openings, etc. – with rebuilding efforts and habitat enhancement. It involves all levels of government, the various fishing interests, First Nations and even non-fishing users of the river. The plan will also include the management of non-salmon fish species and their habitat, in partnership with the Province of B.C.

The first step

The first step, to review the status of all Fraser fish stocks and management practices, is almost complete. Formulating future objectives and evaluating choices and their impacts are the next steps. These will include a consultation process involving stakeholders. The aim is to develop long-term directions for the management of this valuable resource. With over 50% of B.C. salmon coming from the Fraser, the plan will be the cornerstone of the fishery for years to come.



Fisheries science

The action plan's aim to rebuild Fraser salmon depends in part on a comprehensive scientific understanding of the fish species, their behaviour and environmental factors that affect their survival. FRAP studies provide information to guide the effective management of the fishery on the Fraser. With the shortfall of returning sockeye to spawning areas in the Fraser in 1994, one of these important projects has particular relevance: temperature modelling.

Modelling river temperature

High river water temperatures in the summer of 1994 may well have caused many sockeye salmon to die before reaching the spawning grounds. The Fraser River Sockeye Public Review Board recommended the development of a predictive water temperature model for the Fraser; something that FRAP has been working on.

The possibility of global warming has major consequences for Fraser salmon. A rise of a few degrees in river temperature can prove fatal for many returning salmon. With a model designed to predict water temperatures, fisheries managers may be able to modify fishing times and harvests to ensure enough fish return to spawn. Other factors such as water

withdrawals, logging, urbanization and industrial development can also affect water temperature, and the model is expected to assess these too. As well, the model may be used to assess the feasibility of measures designed to lower water temperatures.



A biologist sets up a temperature recorder in the Fraser Canyon.

Temperature recorders at 35 locations in the watershed were monitored throughout the past summer, which provided base data for the predictive model. The project also supplied preliminary data on which tributaries have a warming or cooling effect on the main river. The project is in collaboration with UBC, Triton Environmental Consulting and the Mountain Weather Services Office and the Water Survey of Canada, both of Environment Canada.

Cleaning up pollution across the basin

The goal of reducing the amount of pollution entering the Fraser River basin is a massive undertaking. To address this goal, FRAP's pollution abatement program has focused its efforts on identifying and reducing contaminants entering the Fraser in six main areas: industrial discharges, municipal discharges and urban runoff, agricultural runoff, groundwater contamination, contaminated waste sites and airborne contaminants. A seventh area involves the transfer of technology, an important means of sharing knowledge with the various sectors that can best use that information and with the general public. A large proportion of FRAP's pollution cleanup effort is directed at the main urban centres, which are responsible for the lion's share of pollutants entering the basin.

Ways to stop or reduce pollution

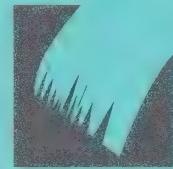
FRAP is finding the best and most cost-effective ways of cleaning up pollution. This includes the identification and review of wastewater control technologies and management practices. Also important is establishing priorities for abatement: which discharges should be attended to first?

Preventing pollution

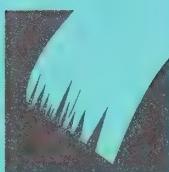
As well as its commitment to minimize pollution, FRAP is developing ways to prevent pollution. One successful approach is to get people in industry and agriculture to adopt more environmentally responsible ways of doing things. To this end, FRAP and various partners in industry and agriculture have published environmental guidelines and codes of practice. Many industrial and agricultural sectors have already benefitted, from horse owners to fish processors, mushroom producers to ready-mix cement plant operators, and guides are planned for many more. The guides have a twofold purpose: they educate people about pollution and its prevention; and they offer practical ideas for ways industries can change their operations to prevent pollution.



FRAP is tackling many different types and sources of pollution.



Other initiatives to prevent pollution include the promotion of economic and non-economic incentives, such as user-pay systems and alternative use of wastes. These encourage industry and individuals to pollute less by making it worth their while to stop or too expensive to continue.



Enforcing anti-pollution laws

An important part of the battle against pollution in the Fraser is the enforcement of the Fisheries Act and the Canadian Environmental Protection Act, and their respective regulations. Both Acts regulate the discharge and/or release of substances into the environment. Enforcement plays an important supporting role to FRAP's objectives in the basin. In cooperation with the provincial government, the long-term enforcement goal is to achieve over 90% compliance with environmental laws. Enforcement's primary tools are site inspections to check for compliance with regulations, the publication of compliance status reports, prosecutions, and court orders for cleanup and restoration. The program works closely with the pollution abatement and prevention components in targeting the worst polluters.

Table 1. Summary of Inspection Activities
1992/93 - 1994/95

Sector	92/93	93/94	94/95
Ocean disposal permits	39	24	32
Pulp and paper mills	20	27	38
Sewage treatment plants	35	40	6
Antisapstain facilities	8	6	7
Wood preservation mills	6	6	16
Wood waste sites	3	3	38
Pesticide applications	9	4	39
Mines	7	7	2
Petroleum refineries	0	1	0
Other Fisheries Act (eg. spills)	17	10	20
Other inspections ¹	157	223	140
Total	301	351	338

¹Includes PCB waste storage facilities, hazardous waste importers/exporters, facilities selling/importing ozone-depleting substances etc.

In 1994-95, the enforcement program conducted 338 inspections of facilities in the Fraser Basin and began 10 investigations into instances of alleged non-compliance. Since 1992, enforcement actions have led to the issuing of nine warning letters, the laying of charges in six cases with eight more still under investigation, and fines totalling \$16,000. In two cases, the proceeds of the fines went to habitat restoration initiatives. Also as a result of FRAP enforcement investigations, the province has issued two pollution abatement orders against companies in violation of the Fisheries Act and provincial Waste Management Act.

Compliance levels continue to vary from sector to sector. Generally, those industries that come under specific regulations – such as pulp and paper, mining and ocean disposal – had compliance rates ranging from 73% to 100% in 1994/95. In sectors that have operations not covered by specific federal regulations – such as municipal effluent discharges, wood waste storage, stormwater runoff and leachate from wood preservation facilities – compliance

levels were not as good. These and other sectors will continue to be inspected and their operations reviewed against the various guidelines and codes of practice under development by FRAP, to ensure they are implemented and the river is adequately protected from pollutant releases.



Focus on environmental quality

In order to measure the success of cleanup projects, FRAP is conducting a comprehensive assessment of current contamination levels in the Fraser and their effects on the health of wildlife, fish and river-bottom organisms. This information will be used as a baseline to check whether the conditions improve as predicted and to highlight which locations and which human activities need special attention. It will also equip managers with a sound scientific basis for making effective decisions about the river's ecosystem. The information is also being used along with habitat knowledge to develop ecosystem objectives.



"Benthic", or river-bottom, creatures give scientists an indication of the river's environmental health.

Indicators of health

Like the miner's canary, the health of sensitive animal species can be used as a measure of environmental health and can give early warning of changes in environmental quality. FRAP has various projects that use fish, amphibians, birds, mammals and river-bottom creatures such as insects as indicators of the health of different ecosystems.

One such study began in the summer of 1994. Slated to last three years, the project is investigating the health of three species of fish in the basin. Mountain whitefish and peamouth chub were sampled from seven different reaches of the river and starry flounder and peamouth chub from the estuary. The study looks for visual indicators of health such as skin lesions and liver colour, as well as the presence of contaminants in fish tissue.

Studying sediments

Many pollutants attach themselves to sediment particles in the water and settle out in quiet areas of the river or in lakes. There they may remain long after sources have been removed. Contaminants in river-bottom sediments affect the health of the bottom-dwelling aquatic life and the food chain it supports. FRAP has been sampling both bed sediments and suspended sediments from many areas of the Fraser and its tributaries to check for toxic contaminants.

Setting targets for water quality

Water quality objectives are limits established to protect certain water uses. They are established after a detailed process that considers all existing and potential water uses and their environmental impacts. In natural areas or those planned for development, objectives are set to preserve water quality; in polluted areas, objectives provide goals for cleanup efforts and afford a way of gauging the effectiveness of pollution abatement.

FRAP is developing water quality objectives in cooperation with BC Environment, for the Salmon River at Salmon Arm, and the Fraser River from Moose Lake (near Valemount, B.C.) to Hope. The joint program is also revising water quality objectives for the river from Hope to the estuary.

Ecosystem objectives

In a new initiative in Canadian environmental management, FRAP is helping communities in the Salmon River watershed near Salmon Arm to develop ecosystem objectives. These objectives describe a desirable living environment that balances environmental, social and economic needs, as defined by the stakeholders themselves. Often, these needs conflict, such as the economic benefits from logging a watershed versus the decline in drinking water quality and loss in recreational fishing values. Ecosystem objectives, once set, can help resolve these types of conflicts: benefits and costs of new developments can be measured against the mutually-developed objectives.



A scientist samples river sediment to check for contaminants.



First Nations and FRAP

The action plan has forged strong partnerships with the Aboriginal peoples of British Columbia, in the effort to restore and enhance the productivity of the river. They contribute their special knowledge and expertise of the river and especially of its fish resources. The river has played a vital role to First Nations people for thousands of years and will continue to do so in the future.

Through the Aboriginal Fisheries Strategy, a federal initiative, FRAP provides funds to Native bands across the basin to carry out dozens of projects.

Habitat restoration and enhancement

Among the many such projects in 1994-95:

- The Nicola Watershed Stewardship and Fisheries Authority constructed rearing side-channels for salmon and trout at two sites along the Nicola River. The group also operated two smolt-rearing ponds for chinook and coho salmon it built in previous years.
- The Shuswap Nation Fisheries Commission operated a fishway on the Bonaparte River, monitoring the number of chinook and coho salmon entering the system to evaluate the success of rebuilding.
- The Carrier Sekani Tribal Council ran seven fish habitat assessment projects on different rivers, including monitoring water temperature and water flow.



Members of the Nicola Watershed Stewardship and Fisheries Authority build a side-channel to benefit rearing salmon and trout.

Fisheries management

Many bands participate in programs designed to help manage the Aboriginal food fishery. Some examples:

- The Tsilhqot'n Tribal Council monitors the Native fishery in its area and, through projects that count sockeye spawners and monitor catches on the Chilcotin River, helps fisheries managers make well-informed decisions.
- Fourteen First Nations with Fisheries Agreements on the lower Fraser in 1994-95 – including the Yale, Sumas, Matsqui, Katzie, Musqueam and Tsawwassen – ran mandatory landing sites and monitoring programs during each fishery to provide accurate counts of the Aboriginal catch.

Enforcing fisheries regulations

Many First Nations, such as the Lheit-lit'en Nation, the Tsilhqot'in Tribal Council and lower Fraser Aboriginal groups participate in the Aboriginal Fishery Guardian Training Program, which carries out enforcement and monitoring activities for the Native food fishery.

Linking maps and information with GIS

FRAP makes extensive use of an advanced computer mapping technology called Geographic Information Systems or GIS. This powerful software tool makes complex information more accessible by creating dynamic links between maps and databases (i.e. geography and information). For example, a biologist using GIS might view a watershed map on a computer screen, and by clicking with a mouse on a particular stream gain access to detailed databases on fish habitat, fish distribution, land use and vegetation relevant to that location. Users can quickly see relationships between these elements, helping them make informed decisions on habitat restoration, fish management, and the like. Some GIS-based projects under way this year include:

GIS for planning

The program is producing GIS maps that illustrate habitat concerns for use in Land and Resource Management Plans (LRMPs) and for municipal planning. GIS is also being used to map wetlands in the Fraser lowland as part of efforts to protect biodiversity and migratory bird habitat. This inventory has assisted in critical land-use decisions: in initiatives to protect green spaces such as the provincial government's Protected Areas Strategy and the GVRD's Green Zones. Recent acquisitions of key wetlands areas in the lower Fraser are in direct response to this inventory.

A digital atlas

In partnership with BC Environment, FRAP is funding a digital Watershed Atlas covering the entire basin. The atlas will combine watershed maps with a new, jointly developed Fish Information Summary System, which will provide rapid and comprehensive fish habitat and fish distribution data on most fish-bearing streams in the province.



GIS is a valuable mapping and database tool used by FRAP personnel to protect and manage habitat.

Informing the public with GIS

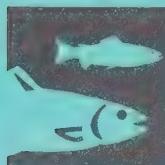
GIS-based technology is a useful environmental education tool for planners, resource managers, stakeholders and the general public. The Salmon River demonstration watershed in Langley uses this technology to make its comprehensive resource information system readily accessible to all concerned. It will allow stakeholders to interactively explore the consequences of different development scenarios.

Groundwater mapping

FRAP, with the province of B.C., has developed a map-based classification system of aquifers in eight selected areas of the Fraser Basin to support groundwater management. Covering a total of 80 aquifers, the system provides a sound foundation on which to manage and sustain the groundwater resource.

Computer models

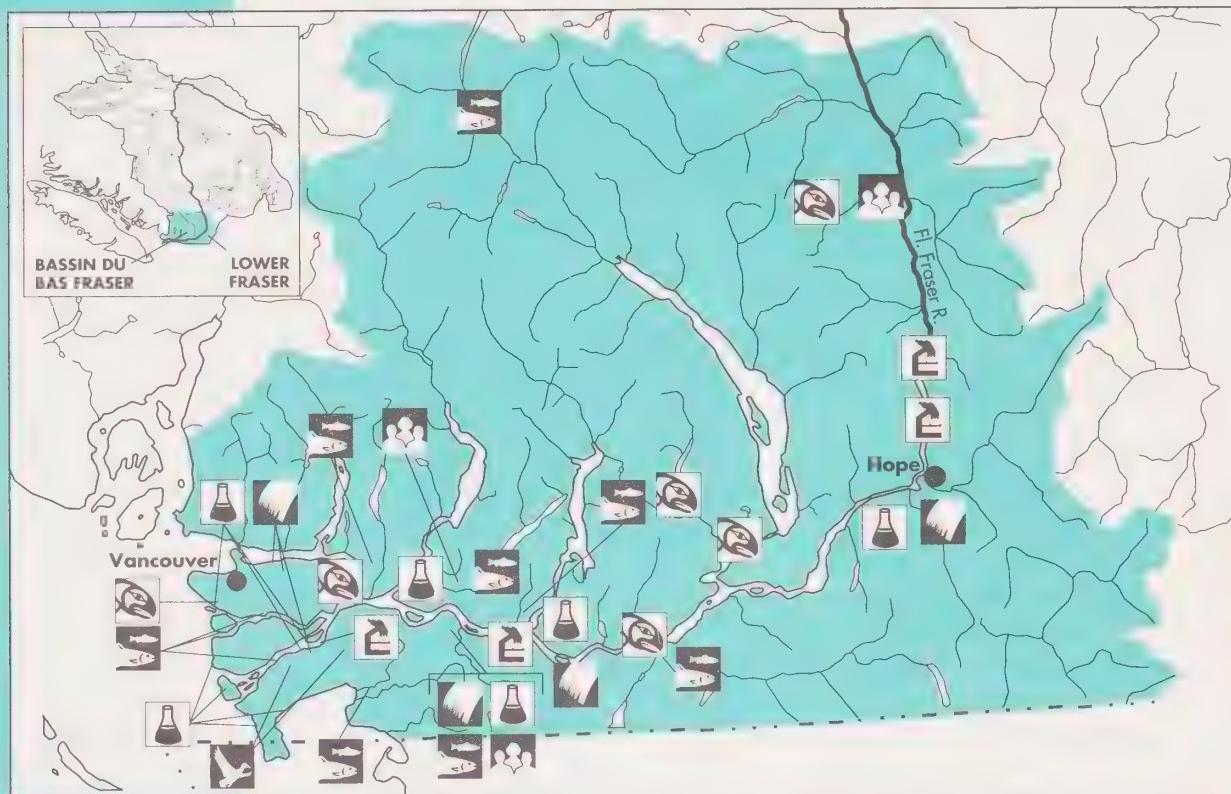
This year saw the start of a new project that creates computer 'models' of the life history of salmon. Called the Integrated Fraser Salmon Model, the project explores the interaction between salmon fisheries and salmon habitat on digital maps by linking salmon catch information with salmon spawning and rearing data. When operational, the model will allow fisheries management and habitat management staff to more easily share information leading to more integrated decisions.



Action in Your Community

The Fraser River Action Plan is working in many communities and regions around the Fraser Basin. The following pages take you on a tour of the basin, stopping briefly here and there to sample the kinds of FRAP projects happening in your community.

Action in the Lower Fraser Basin



Pollution Cleanup



Demonstration Watersheds



Wildlife Habitat



Fish Habitat & Management



Fisheries Science



Environmental Quality



Aboriginal Projects



Spotlight on the Salmon River, Langley: A demonstration watershed

A productive river

The Salmon River provides important agricultural, fish, wildlife and recreational benefits to Langley and the Fraser Valley. This small but productive tributary of the Fraser supports wild coho, steelhead salmon and cutthroat trout. Salmon River headwaters also provide the only known refuge in the Fraser system for the endangered Salish sucker.

Threats from urban growth

Urban development in this rapidly growing area is threatening fish and wildlife habitat

and water quality. In response to this and other concerns, the Township of Langley has teamed up with FRAP, other federal and provincial agencies, UBC, Kwantlen College and public groups in a cooperative effort to manage the Salmon River watershed. Called the Salmon River Watershed Management Partnership, the new organization does restoration work in the watershed, educates the public on environmental issues and gives students environmental work experience through its working group, the Langley Environmental Partners Society (LEPS).

One of the main supporters of the Salmon River watershed initiative, FRAP helped get the management partnership off the ground, initiated the hiring of a watershed coordinator and provides ongoing technical support and advice. FRAP also carries out hands-on habitat restoration work.

The Salmon River watershed is a good example of how partnerships can bring about change. Some achievements so far:

Tackling pollution in groundwater

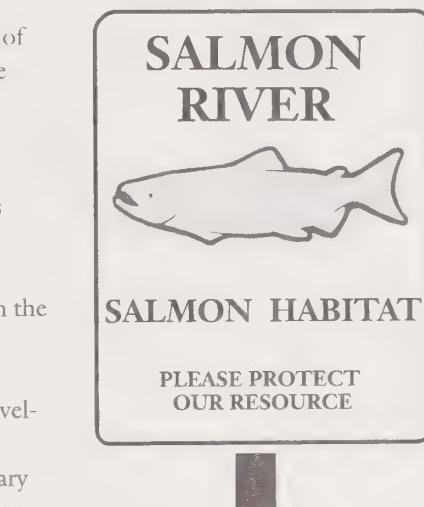
Contamination of groundwater can be a serious problem and LEPS, together with FRAP, the Westwater Research Centre at UBC and BC Environment, have been addressing the issue on the Hopington Aquifer in Langley.

An ongoing water quality sampling program developed by Westwater and supported by FRAP analyzed water samples from 70 wells. Preliminary findings show that 50% of wells have some nitrate contamination, while 13% have nitrate levels that exceed drinking water guidelines. Septic systems, chemical fertilizers and manure are considered the prime pollutant sources, and improved septic system maintenance, limits on urban growth and better manure management were put forward as steps to avoid further degradation of water quality.

Planting trees for fish

One common problem with urban expansion is the continuing loss of trees along the river. When trees go, salmon habitat is seriously affected through bank erosion, which increases the sediment level in the water, and higher water temperatures from lack of shade.

LEPS volunteers, supported by FRAP, are working to reverse this problem along the Salmon River and its tributaries by planting trees. Boy Scouts, Beavers, Girl Guides, neighbourhood associations and other groups have planted about 15 km of river bank with more than 18,600 trees. FRAP has also removed barriers to fish migration and built fences to keep grazing cattle from damaging the stream.



Signs are used throughout the Salmon River (Langley) watershed to raise awareness.



Boy Scouts and other volunteers plant trees along the Salmon River to protect fish habitat.

FRAP is one of the biggest supporters of the (Salmon River) watershed. If it wasn't for FRAP, we wouldn't have been as successful. FRAP got the ball rolling and has provided valuable technical advice. The results we're getting from FRAP are excellent. They assist us but also step back and let us plan, giving us ample assistance when required. Our watershed is an example of what partnerships can do.

**Pete Scales,
LEPS coordinator**



The Greenfields project

In the Fraser delta, farmers have been planting overwintering cover crops such as winter wheat, oats, barley and clover as part of the Greenfields project. It's an innovative way to create important habitat for birds while improving land productivity for farmers.

The Greenfields project is a cooperative venture between delta farmers, FRAP and Ducks Unlimited, and more recently the Delta Farmland and Wildlife Trust. The project aims to improve soil productivity while providing habitat for several waterfowl species, which flock to the delta each winter. At the same time, Greenfields addresses issues of interest to farmers such as crop damage from overwintering waterfowl and the importance of farmland for food production.



welcomed by local farmers – the grazing birds often damage crops. Understandably, there was some initial reluctance to planting cover crops, which would benefit bird populations. However, by planting winter and spring cereals after the cash crop has been harvested, the farmer benefits: the cover crop protects the top soil from erosion, discourages weeds, and when ploughed over in the spring, improves the organic and structural quality of the soil. For the visiting birds, the fields of oats and barley offer good habitat for their winter stay.

A FRAP success story

The project has supported and monitored a total of 980 hectares of winter cover crops this past year – with the participation of 29 farmers. A monitoring program checks each winter cover field at least three times each season. Results show that fields given over to cover crops are extensively grazed by waterfowl.

Greenfields is a FRAP success story. It brings together two groups which historically have not communicated well: agriculture and wildlife agencies. Through good communications – a bi-monthly newsletter, a video, a brochure and a colouring book – Greenfields is spreading awareness of the contribution farmers are making to support wildlife habitat and the importance of agriculture to us all.

Rich in waterbirds and agriculture

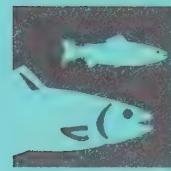
The rich estuary of the Fraser River is extremely productive both for wildlife and agriculture. As part of the Pacific Flyway, the area provides key habitat for migratory birds that stop over for the winter. The estuary and surrounding uplands support the highest winter densities of waterfowl, shorebirds, raptors and Great Blue Herons in Canada. It is also one of the most productive farm districts in the country.

Good for birds... and farmers, too

The annual influx of birds was not always

Salmon streams and urban development

The Lower Fraser Valley is home to over 1.7 million people and is the centre of B.C.'s industrial and commercial life. If current trends continue, this rapidly growing area will increase to three million people by 2021. Most of this population growth is in cities and suburbs, which means spreading urban areas that will encroach on undeveloped and natural areas and threaten fish and wildlife habitat.



Easing stress on urban streams

One of FRAP's priorities is to find better ways to safeguard urban streams in the face of spiralling development. The growth of cities in the lower Fraser Basin has already caused severe loss of fish and wildlife habitat: the Lower Fraser Valley has been extensively diked and drained.

Protection is PPARR for the course

In one of several urban initiatives, FRAP is co-funding a project with BC Environment called Partners in Protecting Aquatic and Riparian Resources or PPARR. The project's goal is to prevent loss of fish habitat before it occurs by influencing the development process.

To do this, PPARR has brought together different levels of government and key stakeholder groups such as the Urban Development Institute, the Federation of B.C. Naturalists and the Union of B.C. Municipalities to find ways to improve stewardship of urban streams. Out of this process, it is hoped that new legislation will emerge that moves the consideration of stream protection and environmentally sensitive habitat closer to the front of the development review process. Currently, environmental reviews are conducted on referred development projects at a late stage – required changes or rejections create considerable additional cost both for the developer and the municipality, and the land in question may already have been rezoned by the municipality. PPARR is also encouraging municipal governments to consider environmentally sensitive areas when community plans are drawn up.

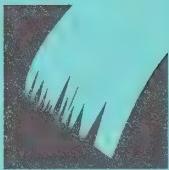
Stream awareness

An important part of FRAP's task is communication, and promoting environmentally responsible urban development is no exception. Publications such as *Stream Stewardship: A Guide for Planners and Developers* are designed to raise the awareness of planners, developers and municipal governments concerning habitat values. The guide also shows how official community plans, zoning and other tools can be used to protect fish habitat and other environmentally sensitive areas. FRAP also produced two other publications: a brochure, *Developing Fish Habitat Signage*, which shows community groups how to use signs to spread awareness of local streams and



A FRAP biologist samples water from a pond that feeds a salmon stream in a Lower Mainland subdivision.

wetlands; and a poster, *Lost Streams of the Lower Fraser*, informs about urban waterways buried, culverted or filled by development and the importance of protecting existing streams.



Turning manure into money

In the fight to reduce pollution in the Fraser Basin, FRAP has some innovative solutions – including the use of economic incentives that make it profitable for industries not to pollute. One project in the Fraser Valley shows how both the environment and the economy can win – even when knee-deep in poultry manure.



A problem with manure

Testing in the Abbotsford area has shown that groundwater contains excessive levels of nitrate, and heavy use of poultry manure by raspberry producers is identified as a major source. To reduce this pollution, new regulations on manure use could be set. But this would entail a long process of development, provincial government ratification and legislation and, if passed, the regulations would require a difficult and expensive system to enforce them.

FRAP is working with the B.C. Ministry of Agriculture, Fisheries and Food and Agriculture Canada to find another solution: sell the excess manure and remove the problem. If markets for poultry litter can be found with sufficient economic value to justify processing and shipping costs, then farmers would have a viable alternative. The study looked at two possible markets which, if fully exploited, could remove as much as 25 percent of the excess poultry manure problem.

Fertilizer market

The FRAP study is looking at the value-added fertilizer business as a possible market for poultry manure. Processed into pellets after treatment to remove pathogens and odour and to add extra nutrients, the manure works well as filler in current fertilizers marketed by local manufacturers.

The ultimate in recycling

A second potential market lies in recycling poultry manure as cattle feed. Long used in the U.S. as a partial substitute for expensive cattle feed, properly processed poultry manure is high in protein, not harmful to animal health, and has no adverse effects on the quality of meat products. It also significantly lowers feeding costs.

FRAP has contracted an internationally renowned animal scientist, Dr. J. Fontenot, whose research led to the poultry litter feed market in the U.S., to help address possible consumer concerns. The consumer acceptance of beef products from animals fed on poultry manure will be extensively evaluated.



Aquatic insects, food for salmon fry, are collected from an estuary marsh.

Evaluating replanted marshes

An important part of FRAP's work is to run scientific checks on progress. How effective are the fish habitat restoration projects carried out in recent years? How can we ensure future projects are effective? One such study is asking these questions about marsh rebuilding projects in the Fraser's estuary.



A haven for small fry

More than a billion salmon fry a year migrate down the Fraser to the sea. On the way, intertidal estuary marshes provide important habitat for fry to rest, feed, hide from predators and acclimatize for the big move to the open ocean. Marshes are rich environments, producing at least 300 types of insects that are food for salmon and some 30 other species. But these valuable ecosystems are fast disappearing – casualties of urban growth and flood-control diking.

Checking marsh productivity

Eleven marsh areas were evaluated in the estuary. The project looked at the whole ecosystem: vegetation, insect life, fish. Samples of each were collected for analysis. Counts of the types and numbers of insects give clues to marsh productivity, while analyses of the stomach contents of fish reveal what they are eating. Chinook fry were also tracked to determine their use of marsh areas. The study pointed to several factors that are critical to marsh productivity: how long marsh areas are under water, and thus available to fish; river currents; and the type of vegetation present in the marsh. To aid managers with future marsh restoration work, the project developed a model that will predict submergence times and river currents for any location in the estuary.

Another aspect of the study compared rebuilt marshes to natural ones. In terms of both insect counts and abundance of salmon fry, the restoration projects scored high marks. Results will be used to help habitat managers plan and design successful marsh restoration projects in the future, both in the estuary and elsewhere in the Fraser.

Checking water quality in the lower Fraser

FRAP is working closely with the Fraser River Estuary Management Program on a number of projects in the estuary including assessment of water quality. This is the first time such an intensive water sampling program has been undertaken in the lower Fraser, and its results will provide critical baseline data for measuring progress toward a cleaner river.





Scientists take samples to test the water quality.

Sampling

The program took samples twice a week at three sites: Oak Street Bridge (North Arm), Tilbury Island (Main Arm) and further upstream at Mission, as part of FREMP's Water Quality Plan. Scientists tested for 151 water quality variables, including a variety of pollutants and contaminants. Sampling at the three river sites and at six sloughs also tested for industrial and agricultural chemicals.

Contaminants increase downstream

Test results showed that, compared to the upstream site at Mission, coliform levels were considerably higher at the two sites and the sloughs in the estuary. Discharges from

stormwater outflows, sewage treatment plants and runoff from urban and agricultural areas are the main sources. In winter, the problem gets worse, when treatment plants stop disinfecting their discharges and heavy precipitation increases runoff and stormwater flows. At this time, and occasionally in the summer, coliform counts are bad enough to present a health hazard to swimmers.

Metal problems

Sampling also showed high levels of some metals, such as chromium, copper, iron and zinc. At times, these levels exceeded federal guidelines and provincial criteria for the protection of aquatic life.

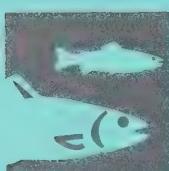
The metals are present both in solution and in sediment suspended in the water – when suspended sediment loads increase, so do metal amounts. Most of the high metal levels were recorded during spring freshet, when high water flows wash more sediment down the river. Samples from the sloughs contained less metal than those from the main river, probably because the lack of current allowed much of the suspended solids to settle out.

Pulp mill traces

The tests also checked for chemicals associated with pulp mill effluent. Results showed low levels, with little differences between the three river sites. Sampling in the sloughs did not detect any traces of pulp mill effluents.

Improving salmon habitat below hydro dams

FRAP and BC Hydro are co-funding several projects to restore lost fish habitat downstream of hydroelectric dams. One such improvement project was started this year along the Alouette River in Golden Ears Provincial Park, below the Alouette Dam.



Strengthening the runs

The Alouette River is one of the busiest sport fishing rivers in the Lower Mainland, thanks in part to the efforts of a hatchery run by the Alouette River Correctional Centre. In the past, the Alouette River used to support wild runs of sockeye and chinook salmon. These are gone – a result of water diversion by the dam. Coho and steelhead runs have recently strengthened, and FRAP's work on the Alouette is designed to boost fish populations by increasing available habitat for these and other salmon species.



Side-channels on the Alouette River open up new habitat for spawning and rearing salmon.

Rebuilding a side-channel for spawners

One improvement project in the upper Alouette opened up a seasonally dry side-channel to year-round flow, allowing salmon access to spawn. Further work improved spawning beds. Steelhead, chum, pink and coho salmon are expected to spawn there, and the revitalized channel will also provide rearing habitat for fry. This habitat is of particular value for coho, which spend a full year in small streams before heading out to sea.

Beaver dam solutions

Further downstream, a large spring-fed beaver pond on the south bank of the Alouette provides excellent rearing habitat for coho – the problem is, a beaver dam blocks access to young fish for much of the year. The project constructed an additional downstream pond and rerouted the existing outlet stream to allow year-round access for juvenile and adult salmon from the South Alouette River into the two ponds. New spawning areas were also created.

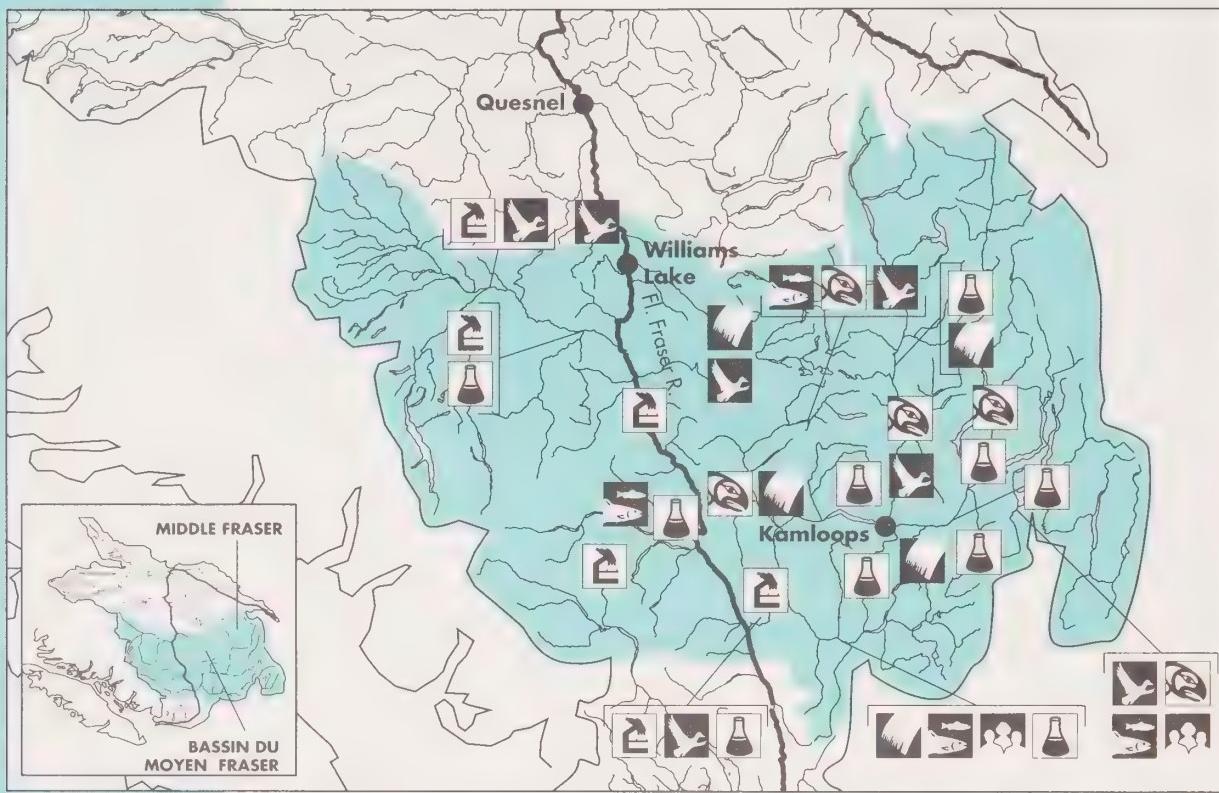
More habitat means more fish

Together, the Alouette River projects built some 6,000 m² of new spawning and rearing habitat and opened up access to much more. The work is expected to produce a quarter of a million more pink and chum salmon fry, 2,500 more coho smolts and benefit trout. Of these, some 3,700 pink and chum and 375 coho adults are expected to return to spawn.

A helping hand from ARMS

Prospects for the river have further improved with the formation of the Alouette River Management Society. It is a community-based initiative to promote stewardship of the Alouette, one of FRAP's demonstration watersheds.

Action in the Middle Fraser Basin



- Pollution Cleanup
- Demonstration Watersheds
- Wildlife Habitat
- Fish Habitat & Management

- Fisheries Science
- Environmental Quality
- Aboriginal Projects



Demonstrating the Nicola River

Another successful demonstration watershed project is under way on the Nicola River near Merritt. This highly productive watershed provides important habitat for fish and wildlife, as well as aquatic plants and invertebrates. The river's water is also in heavy demand by local residents to irrigate crops, water livestock and provide for home, industrial and recreational needs. Ecological importance and high demands for water in this area have created a need for cooperative decision-making among the large number of users in the watershed.

A round table for consensus

With support from FRAP, local groups formed a round table that brought together a broad range of interests. The community-driven round table seeks a consensus-based planning and decision-making process on all social, economic and environmental issues within the Nicola watershed. FRAP plays an active role in supporting a growing partnership among concerned citizens, business and community groups, resource users, First Nations and all levels of government.

"Getting on with the job"

In the past year, with FRAP's assistance, the round table has made positive progress toward achieving its goals. The program has partially funded the hiring of a watershed coordinator to provide information and to help build consensus toward a common vision for the watershed. FRAP also has been providing the round table with important information about the watershed's fisheries and resources needed for sound planning.

Wetlands stewardship

FRAP's Interior Wetlands Project is active in the Nicola River watershed. FRAP, in partnership with local landowners and Ducks Unlimited, is working together to demonstrate good stewardship of wildlife and fish habitats through environmentally responsible farming and ranching. These groups also practice direct habitat enhancement through livestock fencing, tree planting, stream bank stabilization and slough cleanups.

Pollution cleanup

Efforts in the watershed also include cleaning up pollution. FRAP is currently conducting a water quality study in the Thompson Basin, including the Nicola watershed. An aerial survey was conducted and runoff samples collected to measure nutrient and coliform levels in the Nicola River. Analysis of the samples showed that runoff is a potential source of pollution. As a result, BC Environment and FRAP is working with farmers to change practices that cause pollution. Spring runoff information will be given to the round table to assist with planning.

During the summer, FRAP carried out a study of water temperatures in the Nicola River. Fish need cool water to survive, but warm stream temperatures have historically been a problem in this hot part of the Fraser River basin. The results of this study will help guide projects to protect streamside vegetation, which shades and keeps water cool.

Restoring wildlife habitat at T'kumlups

The birds are back on T'kumlups Marshes. Located close to the Yellowhead Highway near Kamloops, two marshes were drying out, as a consequence of highway development, neglect and repeated drought. In August 1994, FRAP, in partnership with Ducks Unlimited, the Province of B.C. and the Kamloops Indian Band, put together a project to restore the dying marshland. The agreement with the band set aside 7.2 hectares of land for wildlife and community use. A system of trails with interpretive signs help enhance the marshland for visitors and raise awareness about the project and wetland areas. Part of the restoration work pumped fresh water into the stagnating marshes. This Interior Wetlands Program project has already reaped benefits: new vegetation, bulrushes and marsh grasses are cleaning up the polluted waters, and birds are returning to breed once more, including yellow-headed blackbirds, redwing blackbirds, mallards and geese.

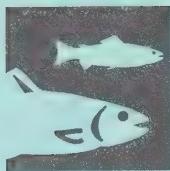
FRAP supplied funding to start up and operate the round table, which has brought people together from all sectors. So far we've established a level of trust. People have more in common than they had thought. It's been positive to have this support (from FRAP), with no strings attached.

**Laurie Guichon,
member of the Nicola
watershed round table**



T'kumlups Marsh is one of many projects to protect wildlife habitat in the Interior.





Enhancing fish habitat along the Nicola River

Work to improve fish habitat along a nine-km stretch of the Nicola River between Nicola Lake and Merritt is a good example of stream restoration projects in the middle basin. Partners include Ducks Unlimited, the Nicola Valley Tribal Council, Tree Plan Canada, BC Environment and local landowners.

Cattle and beaver problems

Fish habitat along parts of the Nicola River suffers from loss of trees and bank erosion. Much of the problem comes from cattle on adjacent ranches that can trample banks and destroy streamside vegetation and from beavers that chew down trees. Few trees for shade, coupled with hot summers in this part of the basin, lead to high water temperatures in the river – and fish populations suffer.

A “riparian” corridor

The project will create a corridor of trees and vegetation along the river bank to protect the stream, provide shade and food for fish (from insects dropping from the trees). This “riparian” corridor is up to 50 metres wide. Fences were also erected to keep cattle away from the river except for a few watering sites, and cages were placed around trees to discourage beavers. Eroding banks were stabilized using tree revetments, a technique that places cedar and pine trees along river banks with one end anchored to the bank. The revetments further enhance fish habitat by providing hiding places for rearing salmon.

Benefits for fish... and ranchers

The protected corridor is expected to improve spawning conditions for 1,000 chinook and an equal number of coho; while improved rearing habitat will help 20,000 to 30,000 smolts of both species to survive their first year. Other fish and wildlife will benefit from the project – and the ranchers win too, since stabilized banks mean no more lost land through erosion.



Tree “revetments” stabilize river banks and provide hiding places for young salmon.

Land use effects on water quality

An important part of the battle to clean up pollution in the Fraser is finding out what impacts different land uses have on the environment. In a study in the District of 100 Mile House, FRAP, in partnership with BC Environment, took a wide-ranging look at land use and its effects on water quality.



Local concerns

Bridge Creek, the main water source for 100 Mile House, drains 1,500 km² of the Fraser River basin. As well as providing water for domestic and irrigation uses, the area's watercourses include highly valued recreational lakes and streams that provide critical fish habitat. Local public health and environmental concerns over water quality prompted the FRAP study, which was conducted between October 1993 and April 1994.

Study findings

The study found that the most significant impacts on water quality came from urban and industrial development; residential development along lakeshores; agricultural land development including livestock winter grazing; and forestry in the lake drainage basins. However, the findings also suggested that water quality problems are produced by many minor sources dispersed throughout the watershed. These are difficult to identify and control and comprehensive watershed planning with active public participation is required.

Livestock wintering sites were a special focus of the study, and the provincial government plans to work with farmers and ranchers to help them find more environmentally responsible ways of operating.



Agricultural land use on the Bridge Creek floodplain, downstream from 100 Mile House.

Planning is the key

Other recommended actions include finding ways to control stormwater in urban and industrial areas; developing environmentally sensitive land-use plans for the upper watershed and for the Bridge Creek flood plain; and establishing a long-term program to monitor water quality in the basin. The key to sustainable water quality in the Bridge Creek basin is an overall management plan developed in consultation with the public, which will put these recommendations into action.



Work on Slim Creek is answering questions about the life history of chinook salmon.



Salmon life history studies

Gaining a clear understanding of the life history and population dynamics of salmon is critical if managers are to set viable goals for stock rebuilding and develop effective habitat management plans. Among the many fish biology studies conducted by FRAP, the following project is answering questions about rearing environments of chinook salmon in several watersheds in the middle and upper Fraser basins.

A mystery year

Most chinook salmon spend their first year in freshwater, before migrating to the sea. Little is known about this critical first year, and this project is collecting valuable data on chinook life history to find out. The information will help determine their productive potential, identify important habitats to protect and reveal factors affecting their productivity.

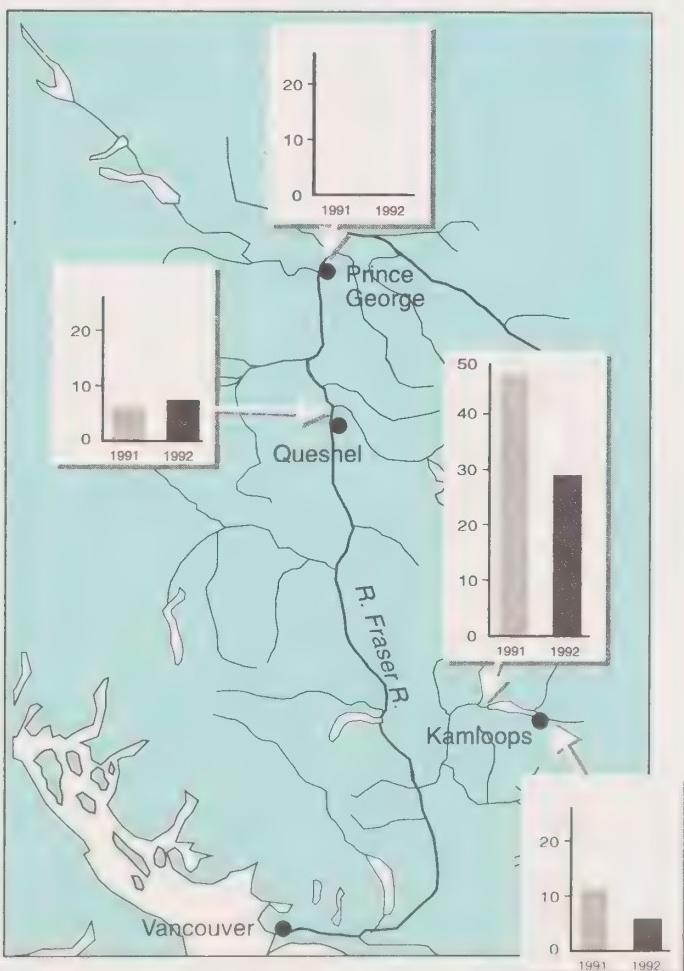
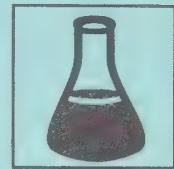
Different spots for different stocks

From April to September, 1994, the project investigated chinook juveniles in two Fraser tributaries, the Chilco River, part of the Chilcotin watershed, and Slim Creek, about 100 km east of Prince George. The study revealed differences in life history between the two streams. In Slim Creek, the vast majority of newly-hatched fry move directly from spawning beds down to the Fraser mainstem, with some making the journey in one night. This suggests the Fraser is the principal rearing area for Slim Creek chinook. In the Chilco, part of a larger system than Slim Creek, fry tend to stay in their home watershed to rear, making the move to the Fraser after about a year, on their way to the ocean. These results suggest size of home stream is one factor affecting choice of rearing habitat.

Results were integrated with earlier work done further north above Prince George, to give a fuller picture of chinook life history in the upper Fraser River. Juvenile chinook are most abundant in the upper reaches, although they are progressively larger at locations further downstream, possibly because of warmer water temperatures, or because larger individuals from the upper reaches and other systems are already moving downstream, beginning their journey to the sea.

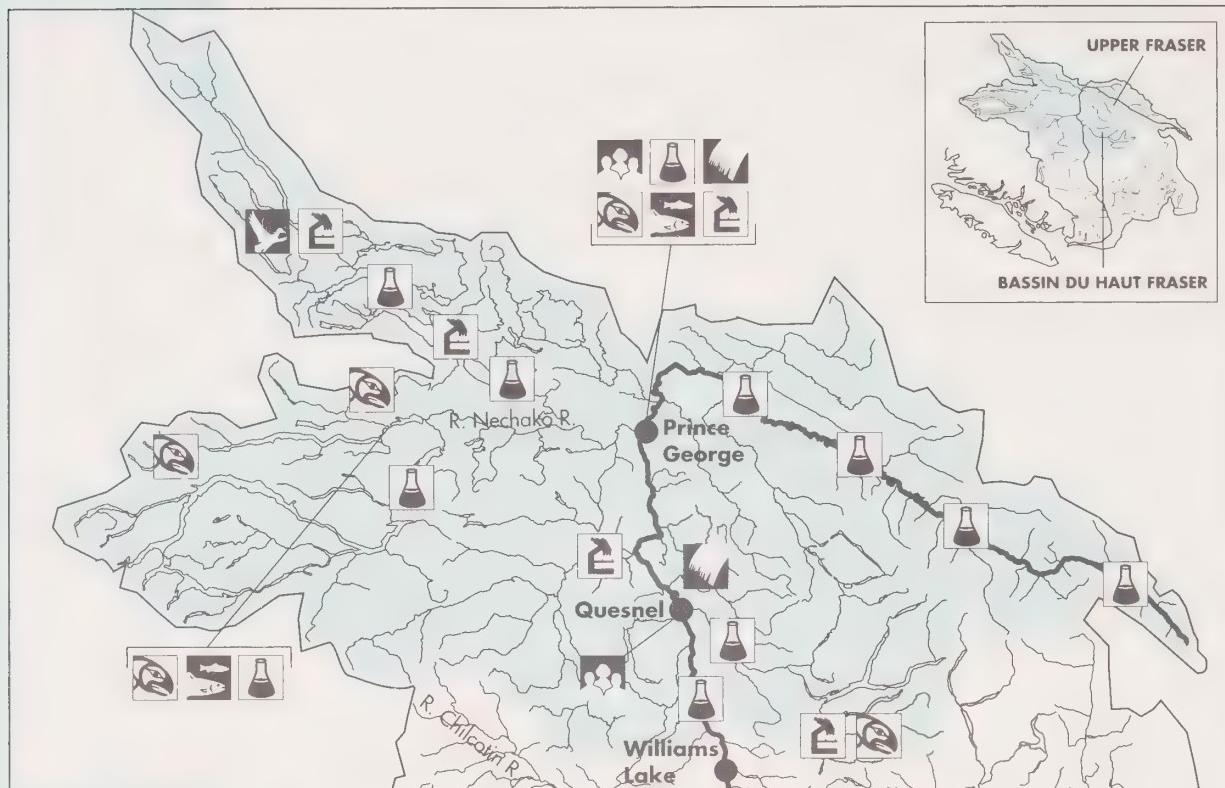
Checking the river's health with ospreys

Ospreys are one of several bird and mammal species used by FRAP to assess the health of the river in the middle and upper basins. These birds feed exclusively on fish, which makes them ideal indicators of river health because persistent contaminants, if present in the river, will tend to concentrate in species higher up the food chain. Scientists are particularly interested in the effects of pulp mill effluent on aquatic wildlife, and one project collected osprey eggs from nests near Kamloops and Quesnel from sites above and below pulp mills. The eggs were analyzed for dioxins and furans. Dioxin levels are higher in eggs collected at downstream nests, but are declining because of the installation of new bleaching technology in B.C. pulp mills. The effect of these lower levels of dioxins is being assessed by monitoring the survival and growth rates of the newly hatched birds in the summer.



Dioxin levels in osprey eggs are decreasing in some areas but are still a concern. [parts per trillion (wet weight)]

Action in the Upper Fraser Basin



Pollution Cleanup



Demonstration Watersheds



Wildlife Habitat



Fish Habitat & Management



Fisheries Science



Environmental Quality



Aboriginal Projects



Protecting sensitive habitat in Prince George

A prime example of an urban centre tackling the environmental problems of rapid growth, the City of Prince George recently embarked on a program to identify and protect sensitive fisheries and aquatic habitat within its city limits. As such it is supported by FRAP as a demonstration project, since many of the issues Prince George is tackling can be applied to other areas in the Fraser Basin.

The city is concerned with rapid residential and commercial development, which may have adverse impacts on fish habitat along the Fraser and Nechako rivers and their adjoining streams. To address these issues, Prince George has taken a number of steps, including developing new environmental protection bylaws, creating stream protection corridors and mapping fish and wildlife resources.

A bylaw to protect streams

The city has formed a good partnership with FRAP and BC Environment and has developed a bylaw that will protect trees along streams. Maintaining streamside vegetation is essential for a healthy aquatic habitat. The bylaw is expected to ensure that development plans include provisions to protect environmentally sensitive areas at an early stage, before any site alteration begins.

Stream protection corridors

Another initiative of the city is to delineate Parkridge Creek as a fisheries sensitive area. This is a first step to incorporating the *Land Development Guidelines for the Protection of Aquatic Habitat*, jointly developed by DFO and BC Environment, into the municipal planning and development process. This stream is an ideal test case: not only is it under increasing development pressure, it is also still in a relatively natural state with valuable fisheries and other aquatic resources. Parkridge Creek supports young chinook salmon in its lower reaches and resident trout further upstream.

FRAP has helped get everyone here talking the same language; people within the city, local agency people and developers together in one room, talking and coming out with a common understanding...a common desire to work together.

Identifying environmental resources

FRAP has provided leadership in identifying the city's environmental assets, both through consultation and through actual resource mapping. The program mapped fisheries resources and sensitive habitat in all streams in the Prince George area, including the Fraser, Nechako and the smaller creeks. Along with the maps are guidelines for the protection of these resources, which can be used in land-use planning.

**Mike Maguire,
special projects manager,
City of Prince George**

Pulp mill checks

FRAP's environmental quality program has targeted pulp mills for special attention because of their large contribution in the past to pollutant levels in the river. Scientific studies such as these help improve our understanding of the effects of contaminants on the complex river ecosystem. This, in turn, contributes to good decisions on the prevention of environmental degradation from pollution and to setting objectives, guidelines and permit levels that protect the environment.



One project has been sampling suspended sediment in the river at six sites on the Fraser and Thompson including upstream and downstream of Prince George, downstream of Quesnel and as far down as Yale in the Fraser Canyon. The Yale site is some 225 km from the nearest pulp mill, but even that far from the source, the study found trace organic contaminants from pulp mill effluent. Highest levels were measured during low flow in the winter. The good news is that the study also showed levels of contaminants such as dioxins and furans are decreasing, thanks in part to new federal and provincial regulations and improved pulp processing technology.

Sticky sediments

The project also looked at what happens when pulp mill effluent, full of organic particles, is mixed into a river rich with clay and silt. The organic particles, which carry many of the contaminants found in pulp mill effluent, tend to attract the smaller clay particles through a process called *flocculation*. The resulting clumped particles are larger, and size affects how far they travel down the river and where they are deposited—larger particles travel less far and settle out sooner. The particle size also affects contaminant intake by insects and other invertebrates that live on the river bottom. Many of these “benthic” animals feed by filtering particles from the water, others graze on deposited material.



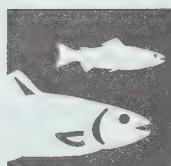
Researcher collects sediment samples near pulp mills.

Mobile labs test effects of pulp mill effluent

At Prince George, another FRAP project is testing what pulp mill effluent does to the benthic community: the plants and animals that live on the river bottom. In the fall of 1994, a sophisticated mobile laboratory was set up at a Prince George pulp mill. Capable of simulating and analyzing isolated aspects of the ecosystem, the lab was used to test the effect of effluent on growth patterns in benthic plants and on the accumulation of contaminants in sediments and invertebrates. Preliminary results indicate that pulp mill effluent stimulates algal growth and alters the numbers and types of species found in river-bottom communities. Lab analyses for invertebrates are not yet complete.

In a complementary project at the same Prince George pulp mill, biologists are investigating changes in physiology, behaviour and disease resistance in young chinook salmon exposed to pulp mill effluent. The data should provide clues to survival, determine whether the effluent is a factor in disappointing rebuilding results for chinook salmon and will be used to review environmental standards for pulp mill effluent. Partners in the work include Northwood Pulp and Timber, BC Environment, the Spruce City Wildlife Association and universities of B.C. and Simon Fraser.

Fish habitat in a city park



Not all fish habitat improvement projects are on remote streams far from the public eye. One recent salmon stream enhancement project, partially funded by FRAP, took place in a popular Prince George city park. And the project took advantage of the public exposure to conduct a little education.

A community-based project

A community group using volunteer labour is enhancing fish and habitat by building a channel leading to the Nechako River. The project involves removing wood debris and excess soil and gravel to allow groundwater to feed the side-channel and providing access to young chinook and trout. The increase in rearing habitat of 2,720 m² will likely produce some 1,850 new chinook smolts. Other terrestrial and aquatic wildlife will also benefit.



Volunteers erect a bridge over a salmon stream on Cottonwood Island.

FRAP is partners with many groups and agencies on the project, including the Nechako Rotary Club, Alcan, the City of Prince George, the Habitat Conservation Fund and several naturalist organizations. As well as helping fund the work, FRAP's role is to provide technical support, supervision, fish and water sampling and analysis.

Informing the public

Situated on Cottonwood Island in Prince George, the enhancement activities afford an ideal opportunity for public education about fish and fish habitat. In fact, this is possibly the most important aspect of the project, which has developed and installed an interpretive program with technical assistance from the Prince George Naturalists.

Wastewater studies at Prince George

FRAP's pollution abatement work in the upper Fraser Basin includes several wastewater characterization studies. These studies analyze the chemical content, toxicity and amount of contaminants in wastewater and help identify their sources.



What's in wastewater?

During the late 1980s, the wastewater treatment centre at Prince George experienced some operating problems caused by toxic discharges that disrupted its secondary treatment process. The centre treats much of the domestic and industrial wastewater from the city, before it is discharged into the Fraser. Relatively high concentrations of cadmium, copper, lead, mercury, molybdenum and zinc were arriving in wastewater at the plant. Since then, concentrations of most of these chemicals have decreased, although copper and mercury levels have continued to be higher than normal.

This last year, FRAP, in partnership with the City of Prince George, funded a study to characterize the wastewater at the treatment centre, identify the sources for the toxic discharges, review measures taken by other jurisdictions regarding toxic discharges and recommend changes to the current sewage bylaw to better regulate waste discharges to the sewer system.

Cleaner sewers

The wastewater characterization study revealed that, in general, the treatment plant was operating satisfactorily, and that concentrations of most measured contaminants were below maximum permitted levels or guidelines. Copper was one exception, and the study traced its source to the leaching of plumbing fixtures in the older areas of the city. The study also recommended ways the treatment plant could better deal with toxic inflows and put forward measures the city could take to reduce the problem at source. These included increasing public awareness of the toxicity effects of certain chemicals and the need to minimize their discharge into sewers, and the development of a revised sewer-use bylaw.

Dispersing effluent

Another jointly funded FRAP/Prince George study evaluated the performance of the new diffuser outfall at the wastewater treatment centre. The diffuser is intended to disperse or dilute effluent from the plant to reduce the impact of pollutants on the river and its ecosystems. A fluorescent red dye was added to the outfall stream, which allowed mapping of the effluent plume to 12 km downstream. The aim was to check the efficiency of the diffuser in terms of the dilution rate and distribution of the effluent down-river. Results show that the diffuser is operating well, and that the effluent discharged from the treatment plant is well dispersed, minimizing impacts on the river.

Studying the effects of logging

FRAP, in partnership with the B.C. Ministry of Forests, has been examining logging effects on fish and wildlife in the Stuart-Takla watershed, 130 km northwest of Fort St. James.



Fish/forestry impacts

Until now, the impacts of logging activities on fish and fish habitat have been poorly understood in the interior region of B.C. Although considerable work has been done in coastal areas, differing conditions make it difficult to apply results to interior watersheds. This long-term scientific study is helping to determine how best to prevent adverse effects

of logging on salmon and habitat. As such it is providing critical information to support and develop the new Forest Practices Code and fish/forestry guidelines for interior regions. The first phase of the project is to collect ecological information from four undisturbed watersheds. As a result, the project has compiled a detailed database on the ecology of undisturbed boreal forest watersheds. Follow-up studies on these experimental watersheds will be able to assess logging impacts with specific knowledge of pre-logging conditions.

Dangers from fine sediments

One potential impact scientists are investigating is the problem of increased sediment in streams from logging activities. Large amounts of fine sedimentation entering streams can reduce spawning areas, and can suffocate salmon eggs by reducing water circulation and oxygen levels. The study found that interior streams tend to flow through areas of finer and deeper soil than in coastal forests, making them especially sensitive to this problem.

Stream temperatures

This last year, the study team completed work on the effects of temperature increases on sockeye salmon egg development. Logging presents a potential risk: fewer trees and vegetation along stream banks means more sunlight and higher stream temperatures. In a lab experiment designed to simulate temperatures found in spawning beds after streamside logging, the team looked at timing and development differences in egg incubation and fry hatching caused by higher water temperatures. The project also collected water temperature data from logged and unlogged portions of the Nadina watershed.

Other project research is looking at forest cover, soils, logging methods, reforestation and the time of year that trees are removed. A program of extensive aerial photography will help monitor changes in stream hydrology and structure caused by logging activities in the future. There are 10 agencies and groups involved in the project, including BC Environment, the Tl'azt'en Tribal Nation, Canadian Forest Products, UBC and UNBC.

The importance of riparian habitat for birds

As part of the development of forestry guidelines in the interior, a clear understanding of riparian bird habitat is critical. Logging operations are often required to leave a buffer strip of trees along streams, and biologists set out to test whether riparian areas were any more important for bird habitat than other forested areas. FRAP scientists conducted a detailed survey of three unlogged creeks, recording the presence and numbers of bird species at 118 different locations. Preliminary analysis of these data show that streamside habitats support the most dense bird populations and a wider range of species.

The project is slated to complete one more year of fieldwork in 1995, and if logging occurs in the area in the near future, there will be the potential to compare results with riparian bird communities from logged areas.



Scientists gather salmon eggs to help determine the long-term effects of logging on aquatic ecosystems in the Stuart-Takla area.

Financial Report

	1994-95
	Budget
	(\$ x 1,000)
Partnerships	
Burrard Inlet Environmental Action Program	415.6
Fraser River Estuary Management Program	382.0
Fraser Basin Management Board and Program	562.6
Communications/Public Involvement	619.0
Demonstration Projects	274.3
Basin Planning	370.8
Program Implementation	831.4
First Nations Participation	3,030.0
Sub-total	6,485.7
Clean Up	
Water Quality	194.6
Improved Science Base	341.5
Pollution Abatement	1,241.0
Environmental Quality	2,177.1
Enforcement	808.9
Economics	383.4
Sub-total	5,146.5
Restoration	
Wildlife Habitat	1,490.7
Geographic Information Systems	280.3
Fish Habitat Management	1,084.5
Fish Habitat Restoration	1,068.5
Fisheries Management	606.8
Improved Science Base	1,721.1
Enforcement and Compliance	135.2
Sub-total	6,387.1
Total	18,019.3
Gov't Restraint	433.0
Grand Total	18,452.3

Appendix A

APPENDIX A: FRAP fish habitat restoration projects

PROJECT LOCATION	DESCRIPTION OF WORK	AMOUNT OF HABITAT BUILT/IMPROVED	EXPECTED BENEFITS
Coquitlam River	Reclaim lost habitat in channels and ponds leading off the river's mainstem.	Increased amount of usable spawning and rearing habitat by 21,000 sq. m.	To produce 50,000 more chum salmon fry (700 adults), and 10,000 more coho salmon smolts (1,500 adults) a year.
Stave River	Increase water flow through previously dry channels downstream of the Ruskin Dam.	Expanded spawning and rearing habitat by 60,000 sq. m.	To produce six million more chum fry (84,000 adults) and 6,000 more coho smolts (900 adults) a year. Also to benefit steelhead and chinook salmon and cutthroat trout.
Alouette River	Create pond and channel habitat off the river's mainstem below the Alouette Dam.	Built 6,000 sq. m of new spawning and rearing habitat.	To produce a total quarter million more pink and chum salmon fry (total of 3,700 pink and chum adults). To produce 2,500 more coho smolts (375 adults) and to benefit trout.
Fraser estuary slough (north arm)	Expand an intertidal slough at the southern tip of the Burnaby floodplain, improve water flow and fish access.	Improved two hectares of intertidal slough as resting and feeding habitat.	To provide some of the one billion young salmon (all species) using the estuary each year with critical habitat.
Fraser estuary cleanup	Remove wood waste and debris choking intertidal marshes at several sites to allow critical habitat to regrow and provide food.	Cleaned up and made available three hectares of rearing habitat.	To open up critical rearing habitat for some of the one billion salmon fry (all species) passing through the estuary each year.
Fraser estuary marsh	Rebuild degraded marshes in the north arm of the estuary, reinforce adjacent river banks and protect foreshore vegetation	Improved 5,500 sq. m of critical rearing habitat.	To provide some of the one billion young salmon (all species) passing through the estuary each year on their way to the ocean with cover and food-producing habitat.
Woods Island slough (near Vancouver Int'l Airport)	Excavate a channel to connect a slough to the north arm of the Fraser, improving water flow and fish access.	Created 500 sq. m of off-channel rearing habitat.	Opened up critical habitat to access by all species of juvenile salmon migrating through the estuary. Provides movement of food and nutrients to the North Arm of the estuary.
Chilliwack River	Stabilize banks to prevent silt from eroding into the water. Build rearing and spawning side-channel in protected floodplain.	Improved water quality along 35 km of river. Built 1,000 sq. m of side-channel.	To improve spawning conditions for about 200,000 chum, 120,000 pink and 20,000 chinook salmon adults. Also improves survival of their fry.
Salmon River (Langley)	Plant trees on river banks to maintain habitat. Also stabilize banks, remove barriers to fish migration and build fences to keep grazing cattle from damaging habitat.	Planted 18,600 trees on about 15 km of river bank to protect habitat. Improved fish access on about 10 km of river.	To improve conditions for 3,000 to 10,000 adult coho salmon spawners, and 150,000 to 200,000 coho smolts. Also benefits cutthroat and steelhead.
Salmon River (Salmon Arm)	Protect habitat by stabilizing eroding river banks, planting trees on banks and erecting fences to keep cattle away. Also create rearing habitat.	Improved and protected habitat along 3 km of river.	To improve spawning conditions for about 500 chinook and 1,000 coho, and to improve rearing for 10,000 to 20,000 smolts of both species.
Nicola River	Create corridor of trees and vegetation along the river to protect stream, erect fences to keep out cattle, stabilize banks, protect streamside trees from beavers.	Protected and improved habitat on 9 km of river from Nicola Lake to Merritt.	To improve spawning conditions for about 1,000 each of chinook and coho, and to improve rearing for a total of 20,000 to 30,000 smolts.

PROJECT LOCATION	DESCRIPTION OF WORK	AMOUNT OF HABITAT BUILT/IMPROVED	EXPECTED BENEFITS
Cottonwood Island Park (Prince George)	Build groundwater channel that feeds into the Nechako River upstream of the Fraser confluence in a city park.	Created 2,720 sq m of new rearing habitat for young chinook salmon.	To produce about 1,850 chinook salmon smolts.
Bonaparte River	Erect a small dam to store water and improve water flows to the river from Bonaparte Lake. Install a fishway and monitoring stations. Also stabilize river banks, plant streamside trees and erect fencing to protect habitat.	Improved water flows, preventing freezing and drying of spawning and rearing habitat, in the upper river. Also planted trees on 1.5 km of river bank, stabilized 200 m and fenced 2 km.	To improve spawning conditions for about 1,500 chinook and 500 coho; and improve rearing for 10,000 to 20,000 smolts of both species.
Birkenhead River	Build series of channels and ponds off the mainstem, as well as culverts to improve fish access.	Created 16,000 sq. m of spawning and rearing habitat.	Produces about 8,000 coho salmon smolts a year.
Deadman River	Restore side-channel for rearing and stabilize river banks to protect habitat. Investigate how to increase water flow in the river during dry periods.	Built 5,000 sq. m of side-channel rearing habitat.	To improve spawning conditions for about 100 steelhead, 1,000 chinook and 1,500 coho, and improve rearing for a total of 20,000 to 30,000 smolts.
Lower River tributaries (Nicomakl, Clayburn, Silverdale, Salwein)	Plant trees on river banks to protect habitat with the help of volunteers	Restored about 5 km of streamside vegetation.	Benefit coho and steelhead salmon and cutthroat trout. Promotes stream stewardship by the public.
Shuswap River	Investigate merits of building a fishway to allow fish access to habitat above the Wilsley Dam.	Would provide chinook access to another 40 km of spawning habitat upstream of the dam.	Would provide spawning habitat for another 5,000 chinook adults.
Yalakom River	Transplant chinook fry in upper part of the river to assess the merits of improving passage at a barrier.	Removing barrier would open up 10 km of productive spawning and rearing habitat.	Chinook and coho would benefit from the increased habitat.
New Westminster islands	Test the feasibility to build up part of the Sapperton sandbar in the estuary to create islands supporting habitat such as marshes and sloughs.	Would create 20,000 sq. m of critical estuary rearing habitat.	Would create productive habitat in an area of the estuary where good habitat has been lost because of development and diking.

Appendix B

APPENDIX B: FRAP wildlife habitat restoration projects

PROJECT	DESCRIPTION	LOCATION	AMOUNT OF HABITAT IMPROVED/ RESTORED (HA)
Greenfields	Cost-sharing stewardship program with farmers which is enhancing farmland for the benefit of migratory birds and waterfowl, which depend on the fields for a wintering feeding area. The program also improves land for agriculture	Surrey and Delta	977 ha this year
Direct Purchase program	Involves securing land for migratory bird habitat through direct purchase with partners, including Wildlife Habitat Canada, Nature Trust of B.C., Ducks Unlimited and Ministry of Environment, Lands and Parks	Fraser Estuary	98 ha
Buckskin Lake Interior Wetlands Program demo project	An old dam built by the previous owner for irrigation was condemned. As a result, the upper marsh dried out, reducing the availability of marsh habitat for wildlife, and leaving the rancher with no reserve water for dry years. Project involves water control and management, planned grazing systems, livestock watering development and cattle exclusion from wetlands by fencing	Williams Lake, West	71 ha
Chilcotin Marshes Interior Wetlands Program demo project	Project involves water control and management, livestock watering development and cattle exclusion from wetlands by fencing	Williams Lake, west	992 ha
Duck Meadow Interior Wetlands Program demo project	Project involves water control and management	Kamloops, east	94 ha
Fallis Pond Interior Wetlands Program demo project	Project involves water control and management, livestock watering development and cattle exclusion from wetlands by fencing	Kamloops, east	5 ha
Harper Ranch Interior Wetlands Program demo project	Project involves water control and management, livestock watering development and cattle exclusion from wetlands by fencing	Kamloops, S. Thompson	30 ha
Kamloops Indian Band Interior Wetlands Program demo project	Project is supplying water to an old sewage pond which was no longer in use, and to marshes which were drying out. Includes water control and management and direct wetland/upland management	Kamloops, north-east	7 ha
McDonald Creek Interior Wetlands Program project	This conservation project was developed in partnership with three landowners, and involves water control and management and direct wetland/upland management	Bridge Lake	54 ha
Nicola River Interior Wetlands Program demo project	Project involves water control and management, planned grazing systems, livestock watering development, direct wetland/upland management and cattle exclusion from wetlands by fencing	Merritt	104 ha
Rush Lake Interior Wetlands Program demo project	Project involves water control and management, direct wetland/upland management and cattle exclusion from wetlands by fencing	Clinton	9 ha
Salmon Arm Indian Lands Interior Wetlands Program demo project	Project involves water control and management and direct wetland/upland management	Salmon Arm	275 ha
Frost Creek Interior Wetlands Program demo project	Project involves water control and management, direct wetland/upland management and cattle exclusion from wetlands by fencing	Williams Lake, south-west	26 ha

If you would like to find
out more about the
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